FORMULÁRIO P2 – TRANSFERÊNCIA DE CALOR E MASSA I

- Soluções para aletas de seção transversal constante:

Case	Tip Condition ($x = L$)	Temperature Distribution θ/θ_b	Fin Heat Transfer Rate q_f
A	Convection heat transfer: $h\theta(L) = -kd\theta/dx\vert_{x=L}$	$\dfrac{\cosh m(L-x) + (h/mk)\sinh m(L-x)}{\cosh mL + (h/mk)\sinh mL}$ (3.75)	$M\dfrac{\sinh mL + (h/mk)\cosh mL}{\cosh mL + (h/mk)\sinh mL}$ (3.77)
B	Adiabatic: $d\theta/dx\vert_{x=L} = 0$	$\dfrac{\cosh m(L-x)}{\cosh mL}$ (3.80)	$M \tanh mL$ (3.81)
C	Prescribed temperature: $\theta(L) = \theta_L$	$\dfrac{(\theta_L/\theta_b)\sinh mx + \sinh m(L-x)}{\sinh mL}$ (3.82)	$M\dfrac{(\cosh mL - \theta_L/\theta_b)}{\sinh mL}$ (3.83)
D	Infinite fin ($L \rightarrow \infty$): $\theta(L) = 0$	e^{-mx} (3.84)	M (3.85)

$\theta \equiv T - T_\infty$ $\quad m^2 \equiv hP/kA_c$

$\theta_b = \theta(0) = T_b - T_\infty$ $\quad M \equiv \sqrt{hPkA_c}\,\theta_b$

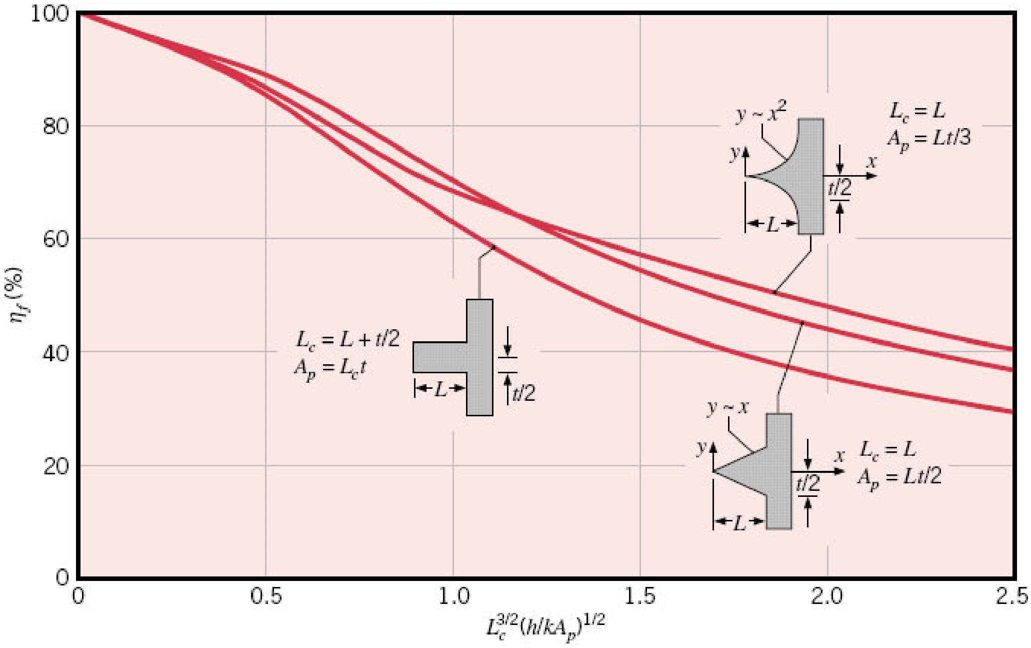
- Efetividade de uma aleta: $\varepsilon_a = \dfrac{q_a}{hA_{tr,b}(T_b - T_\infty)} = \dfrac{q_a}{hA_{tr,b}\theta_b}$

- Resistência térmica de uma aleta: $R_{t,a} = \dfrac{T(x=0) - T_\infty}{q_a} = \dfrac{T_b - T_\infty}{q_a} = \dfrac{\theta_b}{q_a}$

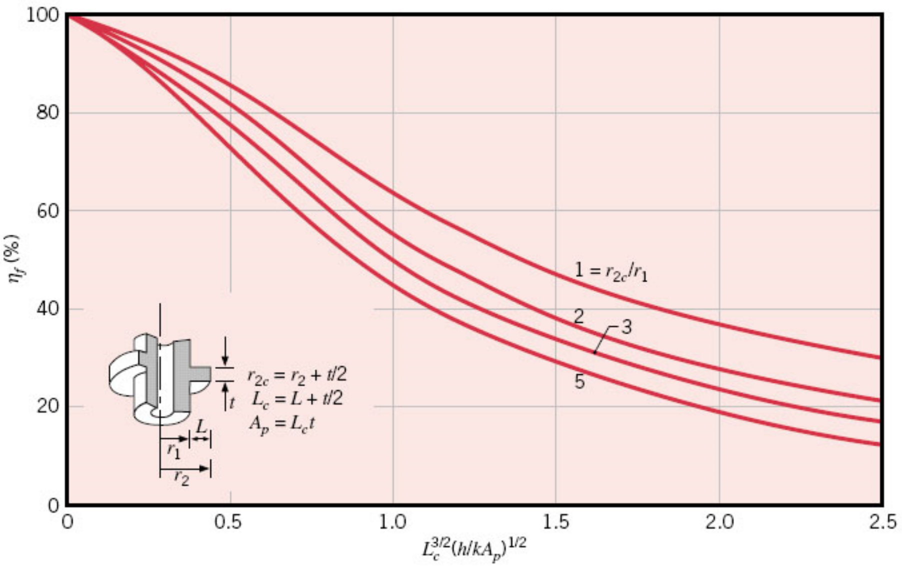
- Resistência térmica convectiva da base exposta: $R_{t,b} = \dfrac{1}{hA_{tr,b}}$

- Eficiência de uma aleta: $\eta_a = \dfrac{q_a}{q_{\max}} = \dfrac{q_a}{hA_a\left[T(x=0) - T_\infty\right]} = \dfrac{q_a}{hA_a(T_b - T_\infty)} = \dfrac{q_a}{hA_a\theta_b}$

- Comprimento corrigido para aleta retangular: $L_c = L + (t/2)$
- Comprimento corrigido para aleta piniforme: $L_c = L + (D/4)$



EFICIÊNCIA DE ALETAS PLANAS (PERFIS RETANGULAR, TRIANGULAR E PARABÓLICO).

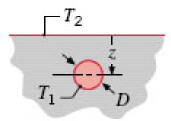
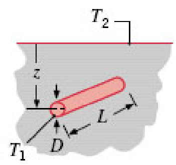
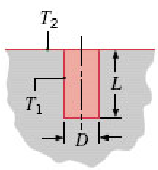
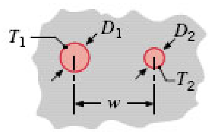


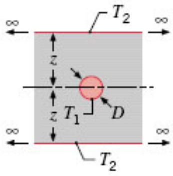
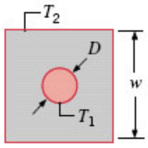
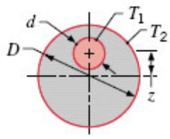
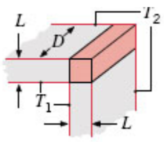
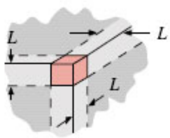
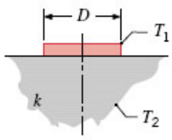
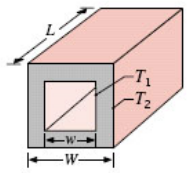
EFICIÊNCIA DE ALETAS ANULARES DE PERFIL RETANGULAR.

- Eficiência global de superfície: $\eta_o = \dfrac{q_t}{q_{\max}} = \dfrac{q_t}{hA_t\left[T(x=0)-T_\infty\right]} = \dfrac{q_t}{hA_t(T_b-T_\infty)} = \dfrac{q_t}{hA_t\theta_b}$
- Área total de transferência de calor: $A_t = NA_a + A_b$
- Eficiência global de superfície: $\eta_o = 1 - \dfrac{NA_a}{A_t}(1-\eta_a)$
- Resistência do conjunto de aletas: $R_{t,o} = \dfrac{T(x=0)-T_\infty}{q_t} = \dfrac{T_b - T_\infty}{q_t} = \dfrac{\theta_b}{q_t} = \dfrac{\theta_b}{\eta_o hA_t\theta_b} = \dfrac{1}{\eta_o hA_t}$
- Eficiência de aleta piniforme/retangular com L_c : $\eta_a = \mathrm{tgh}\, mL_c / mL_c$
- Taxa de calor com fator de forma: $q = Sk\Delta T_{1-2}$
- Resistência condutivo com fator de forma: $R_{t,cond(2D)} = 1/Sk$

FATORES DE FORMA DA CONDUÇÃO

(*a*) **Shape factors [$q = Sk(T_1 - T_2)$]**

System	Schematic	Restrictions	Shape Factor
Case 1 Isothermal sphere buried in a semi-infinite medium		$z > D/2$	$\dfrac{2\pi D}{1 - D/4z}$
Case 2 Horizontal isothermal cylinder of length L buried in a semi-infinite medium		$L \gg D$ $L \gg D$ $z > 3D/2$	$\dfrac{2\pi L}{\cosh^{-1}(2z/D)}$ $\dfrac{2\pi L}{\ln(4z/D)}$
Case 3 Vertical cylinder in a semi-infinite medium		$L \gg D$	$\dfrac{2\pi L}{\ln(4L/D)}$
Case 4 Conduction between two cylinders of length L in infinite medium		$L \gg D_1, D_2$ $L \gg w$	$\dfrac{2\pi L}{\cosh^{-1}\left(\dfrac{4w^2 - D_1^2 - D_2^2}{2D_1D_2}\right)}$

Case 5 Horizontal circular cylinder of length L midway between parallel planes of equal length and infinite width		$z \gg D/2$ $L \gg z$	$\dfrac{2\pi L}{\ln(8z/\pi D)}$
Case 6 Circular cylinder of length L centered in a square solid of equal length		$w > D$ $L \gg w$	$\dfrac{2\pi L}{\ln(1.08\, w/D)}$
Case 7 Eccentric circular cylinder of length L in a cylinder of equal length		$D > d$ $L \gg D$	$\dfrac{2\pi L}{\cosh^{-1}\left(\dfrac{D^2 + d^2 - 4z^2}{2Dd}\right)}$
Case 8 Conduction through the edge of adjoining walls		$D > 5L$	$0.54D$
Case 9 Conduction through corner of three walls with a temperature difference ΔT_{1-2} across the walls		$L \ll$ length and width of wall	$0.15L$
Case 10 Disk of diameter D and temperature T_1 on a semi-infinite medium of thermal conductivity k and temperature T_2		None	$2D$
Case 11 Square channel of length L		$\dfrac{W}{w} < 1.4$ $\dfrac{W}{w} > 1.4$ $L \gg W$	$\dfrac{2\pi L}{0.785 \ln(W/w)}$ $\dfrac{2\pi L}{0.930 \ln(W/w) - 0.050}$